# Obstacles to Maneuver

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ON 28 MARCH 1997 a mechanized brigade combat team rolled west across the desert of the US Army's National Training Center at Fort Irwin, California. The brigade's mission was to attack and destroy an enemy motorized rifle battalion defending key terrain in the southern corridor to set conditions for a future enemy offensive. What made this particular day special was that this unit was the brigade of the future, Task Force XXI. The context for the battle was the Army's Advanced Warfighting Experiment (AWE) for digitization and other future capabilities.

During the previous day and night, the brigade capitalized on its sophisticated intelligence capabilities to discern exactly where the enemy was preparing its array of tactical obstacles. Through digitized terrain analysis, brigade leaders gained appreciation of the terrain's important tactical characteristics. Yet on that morning, the brigade's attack faltered as it approached and then, with difficulty, breached the obstacle. As the obstacles were finally reduced, the enemy remotely delivered scatterable mines to reinforce the breached obstacles in depth and stall the brigade's offensive momentum. The obstacles the brigade had encountered, exactly where anticipated, were in some locations nothing more than wire fence obstacles, in other locations surface-laid antitank mines.[1]

This episode from the AWE underscores trends seen at our combat training centers for years—that an enemy's direct attack on our capability to maneuver significantly affects the battle and that we continue to have difficulty in overcoming maneuver countermeasures.[2] Digitization alone cannot solve these problems. The brigade-level warfighting experiment gave no indication that we were on the threshold of anything more than incremental improvement in overcoming such maneuver countermeasures through Force XXI restructuring.

***[A] direct attack on our capability to maneuver significantly affects the battle and that we continue to have difficulty in overcoming maneuver countermeasures. Digitization alone cannot solve these problems. The brigade-level warfighting experiment gave no indication that we were on the threshold of anything more than incremental improvement in overcoming such maneuver countermeasures.***

The Army After Next effort "seeks to provide the Army of 2020 with the physical speed and agility to complement the mental agility inherited from Force XXI."[3] As pioneers of the AAN effort have begun to explore the characteristics and likely requirements of future battle, they have concluded that "mobility, characterized predominantly by speed of maneuver, proved to be the most important factor contributing to battlefield success."[4] AAN is headed toward a substantial effort to generate significant improvements in mobility for the Army's future force. At the same time, however, we recognize that "any serious military threat between now and the 2025 period will very likely involve asymmetric forces designed specifically to threaten US superiority in areas requiring long development and deployment lead times."[5] Is countermobility an area in which adversaries will focus and negate potential US maneuver superiority? This article examines envisioned AAN operations and addresses why countermobility will be significant to those operations and why this battlefield function should be addressed integrally with the technological, physical and doctrinal developments that will forge the Army's ability to rapidly maneuver.

How does countermobility fit within our doctrine? Understanding our own doctrine suggests the same


The first US tank of the 27th Division to go into action was also the first tank of the division to be destroyed by a mine, 2 October 1918.

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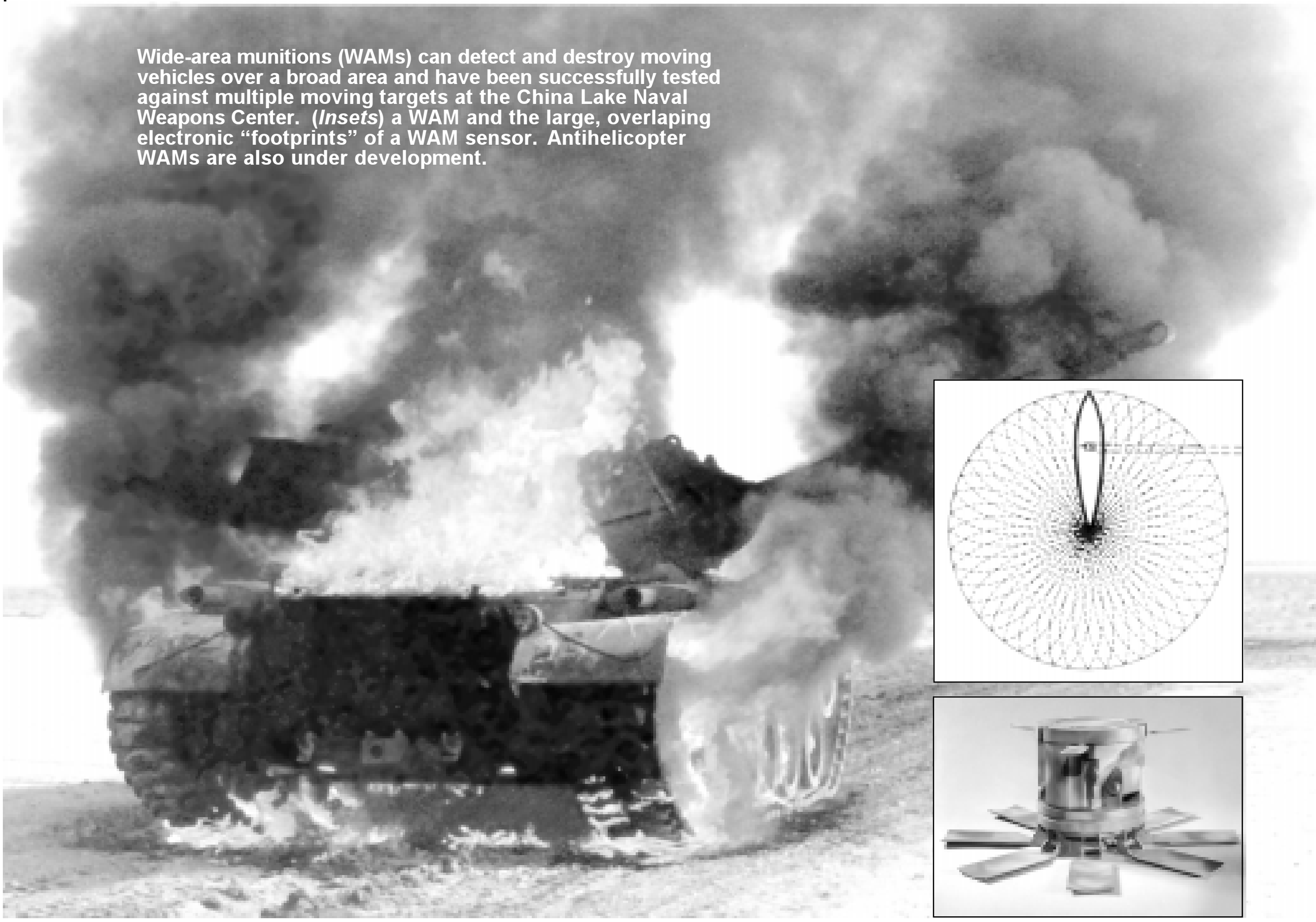
concept might be applied against us. In 1985, the Army published a field manual (FM) titled *Countermobility.* Although not yet rescinded, the FM is outdated and largely ignored, with current and better doctrine articulated in other publications. The draft of the Army's newest FM 100-5, *Operations,* only uses the term *countermobility* once, but close reading of current doctrine reveals that the concept is still valid. Our recent capstone doctrine has simplified and reduced terminology by including the concept of countermobility within a broader context of mobility operations, expanding the latter to encompass "restricting enemy mobility."[6] Still, the 1993 version of FM 100-5 stipulates the purpose of countermobility operations is to "limit the maneuver of enemy forces and enhance the effectiveness of fires."[7] Further, the Army's draft FM 100-5 includes the concept of countermobility within the operating system of mobility and survivability.[8] While not specifically linked in the manual, countermobility directly supports the doctrine's postulated core functions of shaping and striking.

The fundamental concept for the role and purpose of countermobility was reinforced with the publication of FM 90-7, *Combined Arms Obstacle Operations,* in September 1994. This manual addresses the employment of reinforcing tactical obstacles, differentiated from natural obstacles, which are used "to attack the enemy maneuver [and] to multiply the effects and capabilities of firepower."[9] These tactical impediments comprise minefields as well as obstacles other than mines. Countermobility contributes to decision in engagements and battles by degrading an enemy's maneuver, thereby contributing to more favorable conditions for engagement with fires.[10]

Countermobility is accomplished by either physically or psychologically affecting an enemy force so that its ability to maneuver is impeded even more than the difficulties posed by the existing features of the battlespace. Techniques and procedures for countermobility efforts fall into three classes—physical alteration of existing battlespace to cause greater difficulty for movement (digging an antitank ditch, blowing or digging a road crater, digging a pit along an infantry approach, demolishing a bridge); constructing barriers to impede movement (log obstacles, abatis, dragon's teeth, boulders, walls, wire obstacles); and mine warfare. The first two categories pose additional physical impediments to maneuver;



Texatron Defense Systems

Wide-area munitions (WAMs) can detect and destroy moving vehicles over a broad area and have been successfully tested against multiple moving targets at the China Lake Naval Weapons Center. (*Insets*) a WAM and the large, overlaping electronic “footprints” of a WAM sensor. Antihelicopter WAMs are also under development.

***Lagging capabilities and techniques to respond to the developing mine threat disturb maneuver proponents. Mechanical reduction capabilities such as plows, rollers and flails, the same techniques used during World War II, are still commonly fielded. . . . Incorporating tank-like mobility and state-of-the-art technology for controlling a full-width plow blade, [the Grizzly] is actually a countermeasure to . . . first- and second-generation mine threats while a third is already emerging. In short, technology has been and still is advancing the mine threat faster than capabilities to counter mines.***

the last renders psychological impediments as well. Mine warfare combines the factors of lethality and uncertainty, making minefields effective psychological obstacles against maneuver forces.

While “the art of successfully using obstacles against enemy attack is as old as warfare,” our concept of countermobility follows a direct lineage to the start of this century and World War I.[11] Furthermore, the evolution of countermobility in doctrine is linked directly to the cyclic development of technology and warfare.[12] Countermobility and mobility are dynamics within an action-reaction-counterreaction cycle. Within a year of the debut of tank warfare at Cambrai in 1917, the Germans employed crude antitank mines in response.[13] With the interwar development of mechanized warfare, military forces during World War II encountered first-generation antitank mines in vast quantities, as well as new concepts for other antivehicular obstacles such as dragon’s teeth, antitank ditches and demolition obstacles. Even the first scatterable mines were seen by early World War II.[14]

Technological developments within the physical arena of countermobility have been minimal since World War II. The development of concertina wire was a significant development that provided a rapidly emplaceable physical obstacle to dismounted maneuver. Other progress in this area has focused on improved machinery for digging and improvements in explosives technology. However, old techniques such as tank ditches and boulder roadblocks still threaten ground vehicle mobility.

Mine warfare, however, has substantially developed the components of lethality and uncertainty. Since World War II, changes in sensor technology have made mine actions much more complex, and advances in warhead technology have made mines more lethal. Various improvements in delivery and emplacement techniques have yielded mining systems that are rapidly and remotely emplaceable.

Lagging capabilities and techniques to respond to the developing mine threat disturb maneuver proponents. Mechanical reduction capabilities such as plows, rollers and flails, the same techniques used during World War II, are still commonly fielded. In fact, the Army is still developing a modernized countermine capability by mechanical reduction, the Grizzly breacher vehicle.[15] Incorporating tank-like mobility and state-of-the-art technology for controlling a full-width plow blade, this vehicle is actually a countermeasure to what C.E.E. Sloan has delineated as first- and second-generation mine threats while a third is already emerging.[16] In short, technology has been and still is advancing the mine threat faster than capabilities to counter mines. The Army's technology master plan for 1998 observed:

***AAN is headed toward a substantial effort to generate significant improvements in mobility for the Army's future force. At the same time, however, we recognize that "any serious military threat between now and the 2025 period will very likely involve asymmetric forces designed specifically to threaten US superiority in areas requiring long development and deployment lead times." Is countermobility an area in which adversaries will focus and negate potential US maneuver superiority?***

"Mine improvements will likely continue at a rapid pace. Inexpensive land mines can destroy multimillion dollar weapon systems. The future outlook is even more ominous, with the evolution of new smart mines. Micro-electronics will soon take mines to new levels of lethality. The countermine shortfall is particularly worrisome because it strikes at the heart of the Army's doctrine of rapid movement and surprise to win quick, decisive victories."[17]

During AAN wargames in 1997, forces were envisioned with the capability of conducting "an air-ground tactical method of maneuver that combined lighter surface fighting vehicles with advanced airframes capable of transporting them at speeds as great as 200 kilometers per hour over distances in excess of 1500 kilometers. . . . Terrain came to serve a protective and concealing function without restricting mobility." The speed of operational maneuver will push the Army "upward from its traditional two-dimensional spatial orientation of land forces into the vertical or third dimension."[18]

The specific capabilities of this future force have been detailed when describing wargame forces. AAN has stipulated objective criteria to which developers have already designed technologically constrained concept designs. *Knowledge and Speed'*s air-ground concept has been embodied in a stipulated mix of ground vehicles transported in or under advanced airframes, enabling rapid operational and tactical maneuver. The force also has a family of aerial vehicles, all unmanned and operating at different altitudes with varying durations on station, for purposes of reconnaissance and surveillance, air defense, fire support (precision engagement) and $C^4I$ support. These concepts have been refined within technological feasibility to include a 15-ton wheeled advanced fighting vehicle (AFV), transportable and combat-supportable by an advanced airframe (AAF).

Linked to the technological capabilities enabling air-ground mobility at significantly higher speeds and ranges, the AAN effort has produced operational concepts or patterns for how these mobility capabilities will be employed. AAN wargames and a series of earlier OSD/DCSOPS-sponsored Dominating Maneuver Workshops generated concepts for dispersed tactical operations. Enhanced mobility and knowledge facilitate massing effects rather than forces. One example envisioned at a workshop, the "swarm" concept, includes small and dispersed units massing briefly and suddenly in synchronized and decisive combat action against the enemy. The concept included three forces with distinct roles, "pick a path (Eagle), make a path (Tiger) and exploit a path (Cobra)." Elements of a swarm force would execute key tasks, to include emplacing "dynamic" obstacles and breaching.[19] While the swarm concept may be an extreme dispersion, the general trend through the body of all concepts examined at that workshop, and the trend within AAN thought, has been toward dispersed operations. Dispersion and speed are essential for force protection and retaining the force's potential to "pulse" against the enemy with precision and simultaneity.

The AAN vision includes the capability to maneuver that is enabled by a quantum improvement in mobility. *Knowledge and Speed* states that "[F]uture land units will exploit terrain by maneuvering for tactical advantage within the folds and undulations of the earth's surface without suffering the restrictions imposed on mobility by contact with the ground."[20]

This statement might imply that technological advances will allow the Army's future forces to maneuver without concern for natural obstacles or enemy efforts to shape the existing battlespace. But


The guided missile cruiser USS *Princeton* lists heavily to port after striking an Iraqi mine on 18 February 1991. The amphibious assault ship USS *Tripoli* also struck a mine on that day. (Inset) a Navy ordnance disposal expert attaches an explosive charge to an Iraqi-laid LUGM contact mine during Operation *Desert Storm*.

US Navy

***The Navy, with its maneuver through comparatively featureless oceans, has been struggling with mine warfare at least a hundred years longer. Mines are effective sea obstacles at discrete locations on the ocean's periphery where naval forces need to project, as well as in restrictions such as straits.***

AAN's air-ground mobility concept still leaves the AFV and AAF vulnerable, individually or in combination, to countermobility efforts.

Envisioned AAN forces for wargames have included AFVs with robotic mine-detection and neutralization systems. But, the AFV, a 15-ton wheeled vehicle, would have no significantly greater capability against today's array of physical obstacles than current fighting vehicles. Hence, enemy forces might have the capability to degrade the maneuver of AFV-equipped forces. Increased vehicle speed would cause most high-technology, proximity-fused mines such as off-route mines or wide-area mines to have lower probability of effective engagement. Increased speed may also diminish time available for obstacle execution. But increased speed will have no impact on lethality of lower-technology first- and second-generation mines.

Because the AFV is wheeled, it will be more susceptible than a tracked vehicle to effects of nonlethal obstacles such as craters, ditches and rubble. Adding a blade to a 15-ton wheeled vehicle will give it little capability for clearing emplaced, excavated or blasted obstacles. The laws of physics dictate that a substantial amount of work (force X distance) is needed to clear such obstacles back to trafficable conditions. Explosives technologies will offer techniques for reducing physical obstacles but concerns remain, including timeliness of employment, signature of employment and reliability of results. Alternatively, materials technologies may offer potential for filling or building up obstructed terrain, but those developments are in their infancy.

Potential adversaries will have capabilities of yesterday and today to emplace obstacles against the ground piece of the air-ground maneuver force. If they should have the opportunity, then countermobility will have significant impact. While physical-obstacle technology has not changed greatly since World War II, it is now a focus of new research.[21] The ground element of this air-ground force may maneuver rapidly between obstacles, but maneuver may be delayed or stopped at an obstacle unless significant mobility-support advancements, are forthcoming. As noted earlier, more than just keeping pace with mine advancements these efforts would require first catching up, then keeping up.

The Army and DOD are currently embarked on several advanced technology demonstrations (ATDs) that have been incorporated into the Joint Countermine Advanced Concepts Technology Demonstration (ACTD). These efforts are promising in that they pursue the general area of technologies needed to enable a future force to overcome mine obstacles. Even as the research and development continue, three challenges remain to physical agility for the Army After Next.

- Mine-detection and neutralization systems will have to be not only effective but also durable and lightweight.

• Capable systems will have to be employable at speeds that will not unacceptably degrade battle force maneuver.

• Energy sources of feasible weight, power and longevity will have to be available for any directed-energy technologies, particularly for use in mine neutralization.

While the ATDs are a start, overcoming these challenges still requires much work. The AAF would give AAN forces the capability to move over the ground and any emplaced obstacles. Other concepts have been considered for over-the-ground vehicles as future fighting platforms of the land force, freeing the Army from the ground-bound mobility of the AFV.[22] However, while such maneuver would represent a considerable technological development, obstacle and mine responses to counter the maneuver capability are still feasible.

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Precursors of such countermeasures have already appeared. The idea of using terrain for its protective effects while maneuvering above it to avoid its restrictions does little to change the relevance of intelligence preparation of the battlefield, to include terrain analysis of mobility corridors and time-space relationships. Potential adversaries have templated how an opposing force may maneuver, even over the ground, and situational-obstacle capabilities effective against such an over-ground force are within near-term feasibility. Antihelicopter mines have already been developed in the United States and Europe. Under Army contract, two companies have developed concept models for antihelicopter mines that function with sensor arrangements and projected warhead capabilities similar to the US WAM (wide-area munition).[23] The British and Germans have also developed an antihelicopter mine dubbed HELKIR.[24] These types of ground systems, effective against low-flying combatants, exemplify the potential of countermobility. Such technology will enable lethal obstacles that impede *over*-ground maneuver and enhance fires effects, in this case direct fires and fires of air defense weapons that can engage as platforms move to higher altitudes to avoid the mine threat. In FM 90-7's obstacle-effects terms, such mines would offer a capability to "turn" over-ground maneuver in the vertical dimension. With advancements to employ such mines rapidly and remotely, situational obstacles would become very effective against over-ground maneuver.

The mobility solution of moving into the third dimension may well stimulate other innovations that could counter maneuver as rapidly as gains could be realized. Aerial obstacles have been attempted in the past. Over 50 years ago the British produced the "Short and Long Aerial Mine."[25] The devices suspended heavy steel cables from parachutes, intending to disrupt German flying formations during the Battle of Britain. Whether these devices constituted an aerial mine (lethal obstacle) or an obstacle (physical barrier impeding mobility), the idea of using physical impediments in the airspace to counter air mobility is not new or beyond feasibility. A 1980s' update on such a device called a "Skysnare" uses a kite balloon pulling a Kevlar cable obstruction up to an altitude of 300 meters, well above common coordinating altitudes for Army aircraft and the nap-of-the-earth flight altitudes envisioned within the AAN air-ground maneuver concept.[26]

Aerostats, employed for military purposes since the Civil War, also offer renewed potential utility in this arena. They have recently reemerged for air defense early-warning purposes as long station-time platforms for airborne sensors.[27] With development of smaller and more lethal munitions, using such a platform for aerial mines would be feasible. Alternatively, such long-duration platforms could also provide a basis for nonlethal attacks on air maneuver, to include particulate release to degrade or damage air-breathing engines upon ingestion or electromagnetic pulse that would attack avionics, target acquisition, communication and weapon-control systems on fighting vehicles.[28] Such obstacles could be effective even in fixed positions. Clearly, adversaries have a range of promising technological reactions to US pursuit of maneuver ascendancy.

Should AAN operations make the jump beyond AAF/AFV air-ground maneuver and attain true over-ground maneuver, the countermobility experience of the Navy may take on new relevance for the Army. The Army's current countermobility concepts center on obstacles and antivehicular mine employment against a mechanized force and date back primarily to World War II. However, the Navy, with its maneuver through comparatively featureless oceans, has been struggling with mine warfare at least a hundred years longer. Mines are effective sea obstacles at discrete locations on the ocean's periphery where naval forces need to project, as well as in restrictions such as straits.

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Employing future maneuver countermeasures in the airspace may be similar. Obstacles would still be effective where the medium for maneuver becomes constrained—again, around specific locations on the periphery—above the ground on which targets and objectives are located. Low-altitude overground maneuver would be analogous to naval maneuver of a shallow water coastal force—and mines and obstacles could still influence battles when used near key locations. Such employment of future obstacles perhaps extends our current concept of what AAN assaulting forces will face. Unfortunately, both the Navy and the Army have historically given short shrift to countermine efforts.[29]

The significance of countermobility in AAN operations lies not only in the fact that future obstacles or mines may degrade force mobility, causing decisive delays in maneuver, but also significant, the survivability of the force depends on its ability to move rapidly. Giving up traditional forms of protection such as armor plating for gains in the complementary dynamic of combat power, maneuver, risks force protection. According to *Knowledge and Speed,* an air-ground force that bypasses obstacles by moving out of the protective folds of terrain becomes more vulnerable. Since those folds also identify potential axes of advance to opposing commanders who have analyzed their battlespace, countermobility efforts will be an understandably attractive focus for adversaries preparing to confront the Army After Next.

History implies that countermobility will be relevant to battle outcomes as long as vulnerabilities from degraded tempo remain, such as enhanced effects of fires and additional enemy reaction time. History also implies that mines will continue to offer a psychological impediment to maneuver as long as their lethality threatens maneuver platforms and crews. As we build a future force of knowledge and speed, we need to develop and integrate maneuver-support capabilities for the Army After Next. ***MR***

## NOTES

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